YACHT CONTROLLER USER MANUAL

Project BAR 14-6

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Table of Contents

Revisions

Version	Changes
1.0	Initial Version
2.0	Updated safety instructions, drawing and photographs
3.0	Added solve contacts, project number and removed alpha indexes

1. INTRODUCTION/OVERVIEW

The manual provides an overview, operating instructions, a parts list, a list of documentation, and fault finding suggestions for the new yacht controller which replaced and old analogue based controller which was no longer operable.

The new yacht controller consists of a small computer or microprocessor board; two motor driver boards; two motors; two chain loops, one to drive the rudder and one to drive the boom; pulleys and guides; a joystick; four end of travel detectors; a 22 amp hour, 12V DC battery; and a mounting frame. In addition there is an on/off switch and a fuse.

The controller joystick allows manipulation of the the rudder and boom positions on the yacht. A separate battery charger is required but is not part of the controller. The frame is located and strapped to the inside the rear of the yacht, with the electronics stored in a metal box which is part of the frame. Te metal box has a removable cover.

The microprocessor scans the joystick and via the motor drivers updates the speed and direction of the rudder and boom motors. The following parameters are adjustable via changing the software:

Parameter	Value
Rudder motor maximum speed	35% motor maximum physical speed
Boom motor maximum speed	50% motor maximum physical speed
Acceleration/de-acceleration of the boom and rudder motors from stopped to maximum speed (these are not independently adjustable)	Approximately 1 second
Joystick scan rate	.05 seconds
Centre null zone of the joystick for the motor and rudder	10% of the full range of the joystick
The time the chain has to move in the opposite direction to move off the end of travel detector.	1.5 seconds

If the chain reaches an end of travel detector, the motor de-accelerates until stopped. Movement in that direction is suspended until the chain is moved for a specified period of time in the opposite direction and the chain has moved off the end of travel detector.
Each end of travel detector relies on a fixed reed switch attached to the controller frame and a magnet attached to the chain which activates the reed switch when the magnet is close to the reed switch.

2. SAFETY INSTRUCTIONS/WARNINGS

1. The following support crew is **RECOMMENDED** to use the yacht on the water with the controller:
   - a manned motorised boat to follow the yacht while on the water to provide assistance if required;
   - another person on the yacht to provide assistance if required.

2. When servicing the unit's chain loops, motors, pulleys or ropes ensure the unit is powered off using switch S1 and the battery is disconnected by unplugging connector C1.

3. Only charge the battery when the unit is powered off using switch S1 and the battery is disconnected by unplugging connector C1.

4. Do not change the CT UNO microprocessor for a standard Arduino UNO microprocessor as they have different input voltage ranges:

- CT UNO DC 7 15V
- Arduino UNO DC 7 12V recommended

   If a standard Arduino UNO is to be installed than a small power supply has to be installed to regulate the battery voltage below 12 DC.

3. OPERATING INSTRUCTIONS

Operating the unit has been divided into 3 stages: Preparation, On the water and Storage.

Preparation

Steps that must be undertaken before the unit is used:

1. Ensure the battery is fully charged. See the instructions on battery charging.

2. Ensure the controller is operational by connecting the battery to the controller using connector C1, switching the unit on using Switch S1. When the unit is switched on Switch S1 is illuminated. Then ensure the rudder and boom motor respond to joystick commands and that when activated all four limit switches stop the chain movement in the appropriate direction.

3. Always turn off the unit before transporting or moving the yacht.

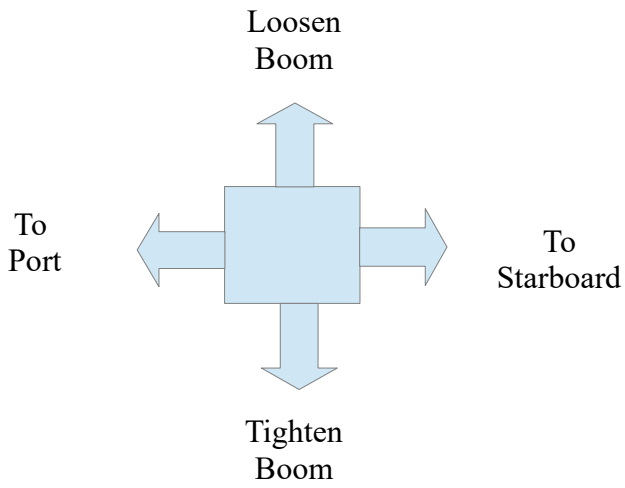
4. Store the joystick in the container provide to prevent damage during transportation.

On The Water - See Safety Instructions

1. Leave the unit switched off while unloading or moving the yacht to prevent accidental engagement of the motors.

2. Before casting off, ensure the controller is operational by connecting the battery if disconnected, switching the unit on using Switch S1, then ensure the rudder and boom motor respond to joystick commands and that when activated all four limit switches stop the chain movement in the appropriate direction.

3. The speed of the motor is dependant on the position of the joystick. The joystick movements are :



4. When either the rudder or boom chain loop is moving and the chain reaches an end of travel detector, the motor de-accelerates until stopped. Movement in that direction is suspended until the chain is moved in the opposite direction for a specified period of time and the chain has moved off the end of travel detector.

5. On completion turn the unit off using Switch S1.

6. If at any time while on the water, the yacht is to be used without the controller, then the rudder and boom chain loops have to be disconnected as the motors cannot be turned by hand with the power off because of the internal gearing. The quickest way to do this is:
   - Reach into the inside rear of the yacht and remove the boom chain loop from the sprocket. The chain can be easily lifted off the sprocket because of the stretch in the shock cord.
   - Reach into the inside rear of the yacht, completely undo the turnbuckle in the rudder chain loop and remove the rudder chain loop from the sprocket.

Storage

1. With the unit switched off disconnect the battery, using Connector C1.

2. Ensure all water is removed from the inside of the boat.

3. Ensure all chains are greased to prevent rust.

4. Inspect all parts and ropes for wear, looseness or damage and repair and or replace as necessary.

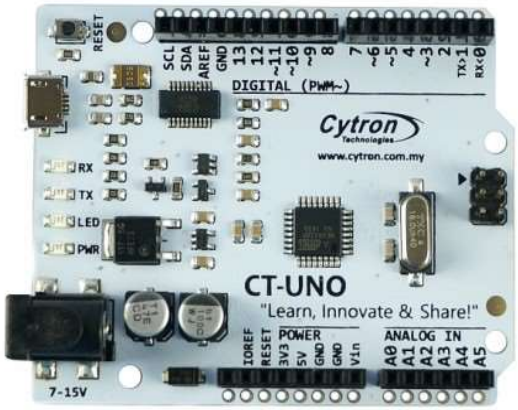
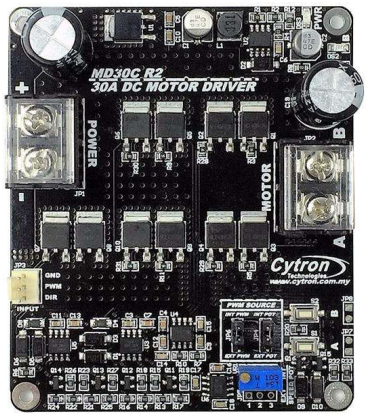
5. Put the timber cover over the cockpit and secure a water proof covering over the timber to prevent water entering the cockpit.

Battery Charging

Before charging the battery, ensure switch S1 is off and the controller is disconnected from the battery by unplugging connector C1. **NOTE: charging the battery with the controller connected to the battery may damage the microprocessor.**

4. PARTS LIST

Where information is available on the parts this has been included in the following table.

Part No.	Item	Image/Description
CPU1	Microprocessor Suppliers Description: Cytron UNO - Arduino UNO Compatible Suppliers Product Code: CT-UNO Supplier: Cytron Marketplace	
MD1, MD2	Motor Drivers Suppliers Description: Cytron 30A DC Motor Driver Suppliers Product Code: MD30C Supplier: Cytron MarketPlace	
M1	Rudder Motor	12V DC motor with: 13 tooth sprocket Maximum speed of 46 RPM
M2	Boom Motor	12V DC motor with: 12 tooth sprocket Maximum speed of 33 RPM
S1	On/Off Illuminated Switch	
F1	30 A Main Fuse	Automotive standard blade fuse

J1	Joystick Suppliers Description: Joystick Potentiometer JH-D202X-R4 10K 2-axis Sealed PTZ Thermistor Supplier: eBay seller mondaynight2013.	
S2, S3, S4, S5	Reed Switches	
M1, M2,	Replaced Magnets Suppliers Description: Neodymium Block – 20mm x 6mm x 3mm N52 Suppliers Product Code: 22023B Suppler: AMF Magnetics	
M3, M4	Original Magnets	
CRL	Chain Rudder Loop	800mm of standard single speed bike chain size: number 410 1/8" x 1/2”
CBL	Chain Boom Loop	1,570 mm of standard single speed bike chain size: number 410 1/8" x 1/2". 6mm shock cord.
	Rope to boom	6mm multi purpose rope.
B1	Battery Suppliers Description: 12V DC 22AH AGM Deep Cycle Battery Suppliers Product Code: CBC12V22AH Suppler: Battery Store	

5. DOCUMENT LIST

The following documentation is available:

Part No./ Description	Documentation Location
CPU1	User Manual
MD1, MD2	User manual
Yacht Controller Users Manual V1	Git Hub Repository: https://github.com/vonkratzmann/Yacht_V1.git File Name: Yacht Controller Users Manual V2.odt
Software	Git Hub Repository: https://github.com/vonkratzmann/Yacht_V1.git File Names: *.cpp, *.h, *.ino
Circuit Diagram	Git Hub Repository: https://github.com/vonkratzmann/Yacht_V1.git File Name: Yacht Circuit Diagram V2.dsn Yacht Circuit Diagram V2.png see Appendix 1
Controller Image	Git Hub Repository: https://github.com/vonkratzmann/Yacht_V1.git File Names: Controller Layout.jpg see Appendix 1
Boom Cable Configuration Images	Git Hub Repository: https://github.com/vonkratzmann/Yacht_V1.git File Names: BoomCableConfiguration1.jpg BoomCableConfiguration2.jpg see Appendix 1

6. FAULT FINDING

Issue	Actions
1. No power.	1. Check battery is connected using connector C1. 2. Check switch S1 is turned on, S1 should be illuminated when switched on. 3. Check fuse F1has not blown. The fuse is rated at 30A. Each motor driver board is rated at 30A continuous output and 80A for 1 second. On the bench the motors draw approximately 9A. As the motor driver boards do not have any output over current protection, if there is a fault on the motor then the fuse should blow before there is any damage to the output driver boards. 4. Check for loose, broken or unplugged connections or cables.
2. Joystick not operating.	1. Check power. 2. Cycle the power from on to off to restart the program in the microprocessor. 3. With the power off, remove the cover from metal box housing the electronics and remove the electronics. 4. To remove the electronics, remove the two Nylon capture nuts at the bottom of the metal box housing, then lift up the controller using the DIN rail and slowly remove the controller being careful not to catch any wires on the cover mounting brackets. Turn the power back on. 5. The microprocessor has a power on led “PWR”, see picture of microprocessor. This should be on, if not check power. 6. The microprocessor has a software diagnostic “LED”, see picture of microprocessor. This led continually flashes on for a second, then off for a second. The led indicates the software is running in the microprocessor. 7. Check for loose, broken or unplugged connections or cables. 8. A laptop running the Arduino development environment and loaded with the source code can be plugged into the microprocessor. Within the code, debugging options can be enabled which display on the laptop the position of the joystick and the speed of the motors.
3. Both motors not operating.	1. See issues 1 and 2 above.
4. One motor not operating.	1. With the power off, remove the cover from metal box housing the electronics and remove the electronics. 2. To remove the electronics, remove the two Nylon capture nuts at the bottom of the metal box housing, then lift up the controller using the DIN rail and slowly remove the controller being careful not to catch any wires on the cover mounting brackets. Turn the power back on. 3. Check for loose, broken or unplugged connections or cables.

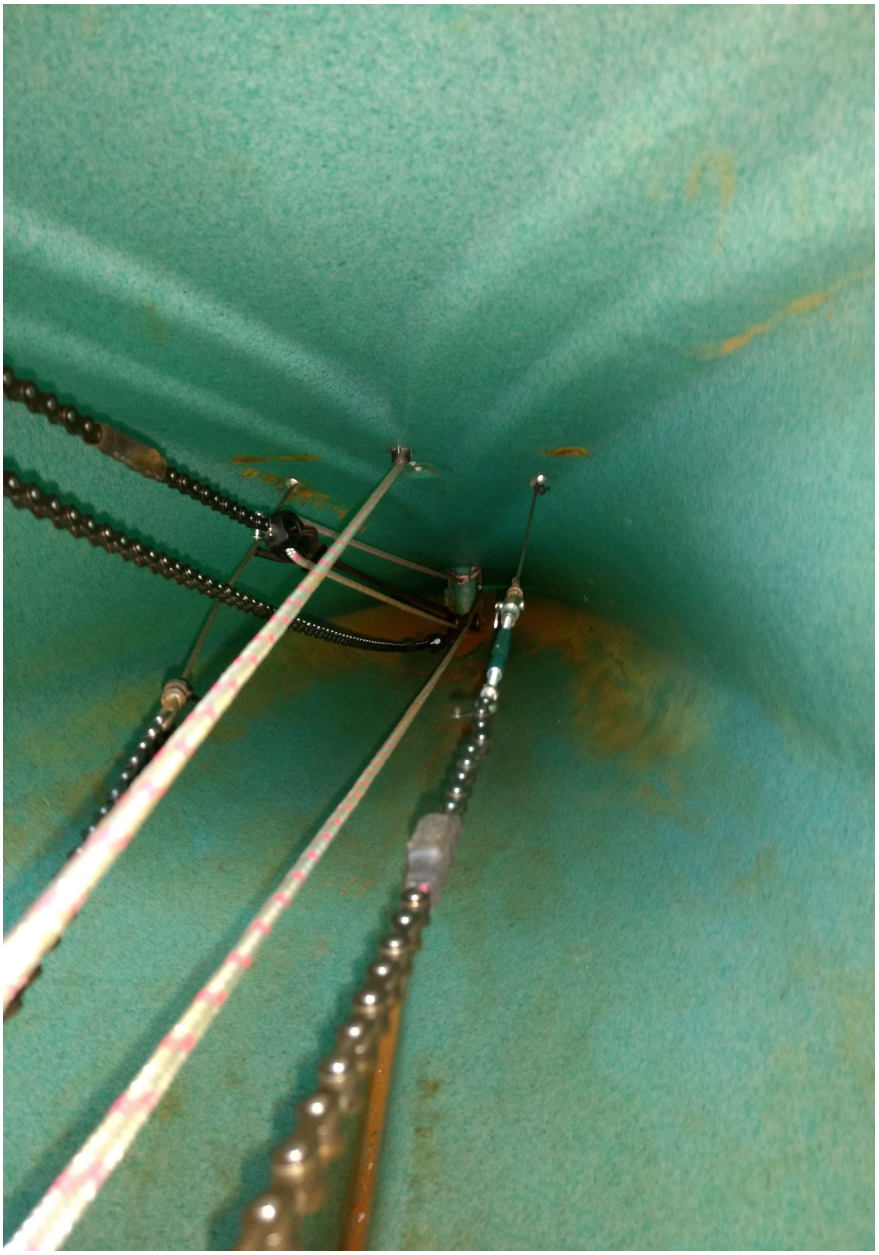
	4. The motor driver board has a power on green led “PWR”, see picture of motor driver board. This should be on, if not check power. 5. Operate the joystick in both axis, on the motor driver board Red LED A turns ON when the output B is low and output A is high. Indicates the current flows from output A to B. 6. Operate the joystick in both axis, on the motor driver board Red LED B turns ON when the output A is low and output B is high. Indicates the current flows from output B to A. 7. Depress Test Button A, when this button is pressed, current flows from output A to B and motor will turn CW (or CCW depending on the connection). 8. Depress Test Button B when this button is pressed, current flows from output B to A and motor will turn CCW (or CW depending on the connection). 9. To assist with isolation of the fault, the motor can be disconnected from the motor driver board by disconnecting the crimp bullet connectors and connecting the motor via a cable with an inline fuse directly to the battery.
5 End of travel detectors not working.	1. Check for loose or lost magnets on the chain. 2. With the power off, remove the cover from metal box housing the electronics and remove the electronics. Turn the power back on. 3. Check for loose, broken or unplugged connections or cables. 4. Activate the reed switches, using a magnet, if operating correctly the diagnostic LED on the microprocessor will flash on and off for a quarter of a second each time the reed switch is activated or de-activated.
6. Cables tangled or broken.	1. Ensure the unit is switched off using S1 and the battery is unplugged by disconnecting C1. 2. Remove the controller frame to untangle or replace broken cables. 3. The controller frame is removed by : - Removing the three stainless steel pipe straps that hold the controller frame to the horizontal pipe that runs across the inside rear of the yacht. Note: there is a small piece of wood between the controller frame and the horizontal pipe that runs across the inside rear of the yacht. The piece of wood is on the left hand side of the controller frame looking towards the rear of the boat. This is to align the pulley attached to the end of the arm on the controller frame with the exit point off the rope which is connected to the boom. - Inside the rear of the yacht remove the boom chain loop from the sprocket. The chain can be easily lifted off the sprocket because of the stretch in the shock cord. - At the exterior rear of the yacht slide one side off the stainless steel

	cable off the pulley above the rudder. - Inside the rear of the yacht remove the rudder chain loop from the sprocket. This can tight, if too tight, loosen the turnbuckle in the chain loop. - Partially slide the controller frame out until the rudder chain loop catches on the battery support. - Completely undo one end of the turnbuckle to allow the frame to fully slide out. - To remove the controller frame from the yacht, remove the pulley off the end of the arm on the controller frame. - The frame can now be completely removed from the yacht.

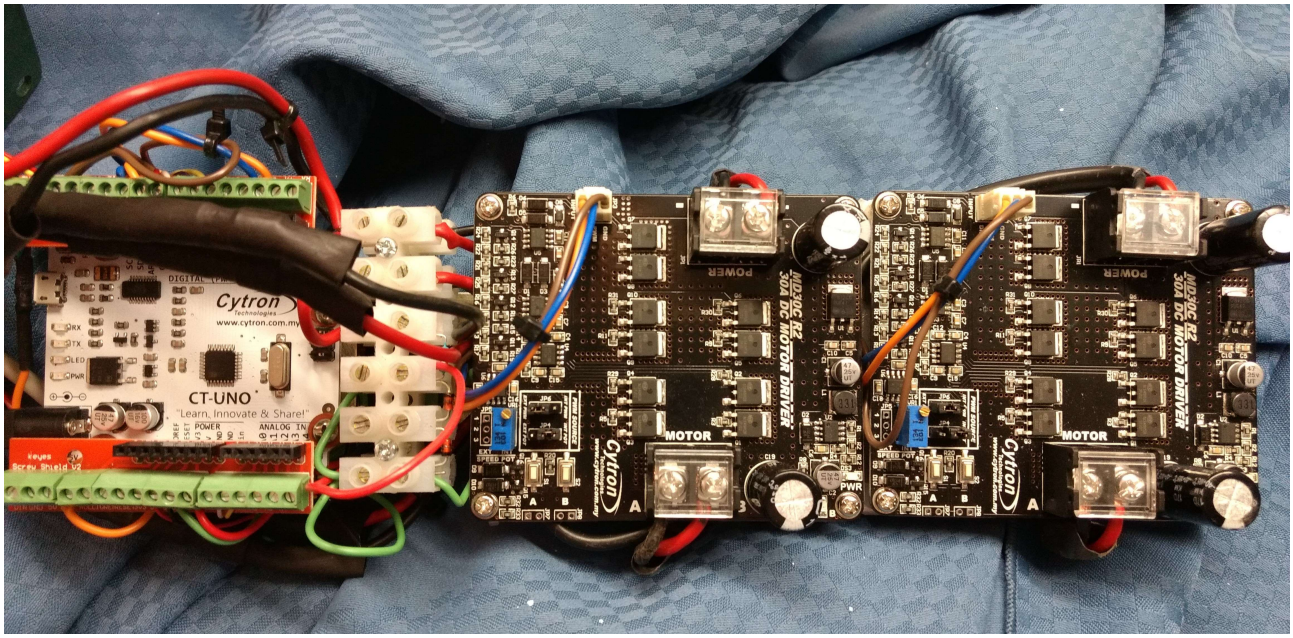
APPENDIX 1

BoomCableConfiguration1

BoomCableConfiguration2



Controller Layout Picture



Circuit Diagram